Machine Learning and Font Design -- Taking the Print Advertisement Generated by Artificial Intelligence As an Example

Jianjun Fang[1]*
College of Art and Design, Beijing University of Technology, Beijing, China
***Corresponding author, e-mail: 2605617837@qq.com**

Abstract: With the gradual maturity of artificial intelligence, the field of artificial intelligence and print advertising has been widely combined, and the generation of print advertising intelligence has been widely used. However, AI generated print ads have gradually exposed its shortcomings in font design. Only relying on a single copyright font library for graphic combination, it is easy to cause the font and advertising theme is not appropriate, the font and brand image positioning is not consistent, and the font and advertising claims are not up to standard. Therefore, the introduction of machine learning font design into the field of print advertising has a certain practical value.

Keywords: Machine learning, Font design, Print advertising, eye movement experiment

1. Introduction

Artificial intelligence has gradually matured. Machine learning and in-depth learning have been widely combined in the field of print advertising. On the one hand, it has liberated the designer's complex and huge basic design links and reshaped the design ecology; on the other hand, it also impacts the inherent structure of "subject design third party design result", moving towards the dual framework of "subject appeal design result". The diversified and efficient generation of AI design ability makes the design third party infinitely weakened, and the public enjoys the direct expression of self charm.

Facing the current market situation of short life cycle, fast replacement speed and strong serialization of print advertising, a large number of "one key generation" artificial intelligence print advertising design software have emerged at this stage, which can efficiently generate demand posters and various print advertising. However, the font design of this AI generated print advertisement is often unsatisfactory. It only relies on a single copyright font library for plane combination. Therefore, the positioning of font and brand image and the unique expression of user demands are not suitable. Therefore, the introduction of machine learning font design into the field of print advertising has a certain application value.

This paper attempts to summarize the existing technology and development of machine learning font design, which shows that machine learning font design itself is mature; Taking arkie software as

an example, this paper points out the problems and defects of font design in "one button POSTER" from the three aspects of font design principles in print advertising, namely, font morphological characteristics, recognition characteristics and cognitive characteristics, and affirms the necessity of introducing machine learning font design; Finally, through the combination of subjective questionnaire evaluation and objective eye movement experiment, Carlo analysis is carried out on the intelligent design of print advertising introducing machine learning font design, test its user satisfaction, and demonstrate the application value of introducing machine learning font design into print advertising.

2. Development of Machine Learning

2.1 Machine Learning and Art Design

Today, with the application and development of convolutional neural network and the continuous improvement of the depth of artificial intelligence machine learning, it has reached the generation innovation in the unsupervised state, and has the possibility of independent "creation" in art design. Art and design is no longer an absolute professional field, but an invitation to the public: no matter what your major is, whether you have creativity or ideas, you can enjoy non mechanical reproduction and your own aura.

In 2015, Google launched the "deep dream" art generator. It can randomly select a layer of neural network to repeatedly process a specific picture for a given number of times and deformation degree. Customers upload pictures with their own distinctive style. The machine uses deep learning technology to automatically identify complex details such as contour, texture and stroke, and deconstruct and reconstruct them without manual instruction and debugging, Automatically write the fitness function with aesthetic significance, and creatively produce a classic painting with strong personal characteristics with the theme selected by the customer. If customers need it, they can also

choose to graft their own style with the painting style of an artist to form a wonderful mix and match effect.

Figure 1 Deep dream generates pictures

In 2016, a number of big data scientists, software engineers and artists from Microsoft, Delft University of technology, morates Royal Art Museum and Amsterdam Rembrandt Museum created a Rembrandt style painting with artificial intelligence program after 18 months of joint efforts, and named it the next Rembrandt. These interdisciplinary experts first analyzed 168263 fragments of Rembrandt's past works by using technologies such as big data, 3D scanning and machine learning,

and then transformed Rembrandt's painting habits and work details into data training AI system. After in-depth learning, the AI system "creates" a new digital painting that is different from any previous works of Rembrandt but has a very similar style. The painting vividly reproduces the painting style and stroke of the famous painter in the 17th century, as if it were Rembrandt's own new work.

In 2017, the laboratory jointly established by Disney and Carnegie Mellon University published a paper "a deep learning approach for generalized speech animation" , the method of deep learning is used to generate voice animation. In the creation of traditional animation, the original painter needs to complete the drawing of basic drawings, and then color these original drawings. The ordinary animation of 12 frames per second needs to be drawn one by one by the original painter, and the animation of 20 minutes needs to draw tens of thousands of drawings to complete, which is a very large production project. And machine science In September of the same year, George Hastings released the khroma online color tool(http://khroma.co/). This is a color matching system developed based on artificial intelligence. It generates a very practical color matching scheme based on the analysis of the colors selected by users, and realizes a higher precision combination with words and pictures.

In July 2019, the Chinese artificial intelligence robot Microsoft "Xiaobing" held its first solo exhibition "probable world" in the Art Museum of the Central Academy of fine arts , this is Xiaobing's independent painting creation after learning from 236 world-famous painters in the past 22 months using Gan model. These paintings have been refined into six personalities, covering the late ukiyo style, partial Cubism style, partial bonard and vial style.

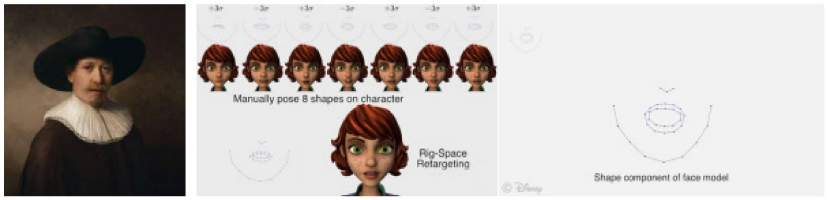

Figure 2 "The next Rembrandt" Figure 3 "A Deep Learning Approach for Generalized Speech Animation "

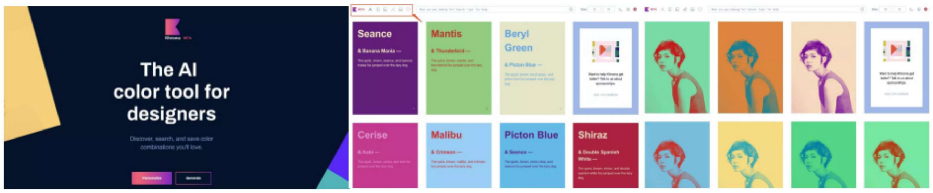

Figure 4 Combination effect of words and pictures of home page and color matching of khroma website

2.2 Machine Learning and Font Design

Single sample machine learning font generation means that the object of machine learning is a single font with a unified style, and all characters in the font library are improved by imitating the

sample. Single sample machine learning font generation is mainly used in the font library of personal handwriting and the digitization of calligraphy. Being able to break away from the style imitation of the original sample and create a new font style and style is the basic attribute of machine learning font design applicable to the field of print advertising. Users describe and select the preferred font style, generate a new font through intelligent training, and adapt to print advertising.

The open source project zi2zi is a machine learning model for learning a variety of font styles to generate new font styles. It is a depth model for Chinese character generation based on Gans. Zi2zi realizes the automatic conversion from source font to target font, and does not need to model the hierarchical relationship of strokes. Based on the network structure of pix2pix, the model can generate a variety of fonts with different styles. Designers can design fonts by themselves only after years of training, understanding the structure and construction of fonts, and analyzing a variety of font styles and styles. Based on this principle, zi2zi model establishes a model that can recognize and learn a variety of font styles. Zi2zi model makes the encoder not only contact the target font, but also contact all combined fonts at the same time, and learn different writing methods of the same radicals of various fonts. Zi2zi is usually applied to the conversion between standard fonts or artistic fonts. In model training, the same character can be obtained between two fonts by continuous transformation in different font styles and interpolation between different styles. This "transition" font continues to be trained and finally generates a new font with multiple styles, Complete the font design.

Matthew Carter is a font designer from the UK. He has produced many fonts for apple, Microsoft (screen font) and Time magazine. He took machine learning font design as an art experiment, and continued to deconstruct 2674 Google fonts in continuous model training. The fonts were deformed in maintaining a certain recognition, and he looked for interesting forms in this unpredictable transformation.

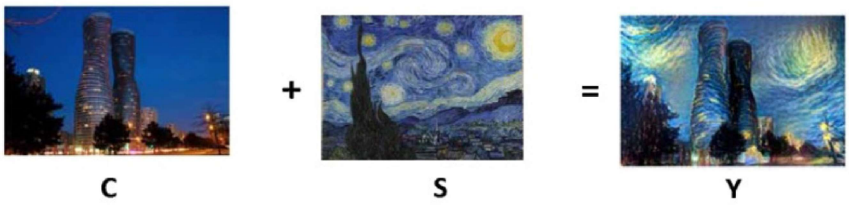

Figure 5 Zhang Guozhou's attempt to transfer font style

The font generated by machine learning in the above way may depend on the shape of the input font, so it is difficult to generate a completely novel font. In 2019, Hideaki Hayashi proposed a style consistent font generation model called glyphgan based on generation confrontation network. Using Gan framework to create new fonts can generate unlimited types of fonts by independently controlling fonts and styles, and maintain the style consistency of all fonts. The fonts generated in this way have higher readability and diversity. Hideaki Hayashi also said that they plan to use vector images with contour control points in their future work, so that the generated fonts are not limited by resolution and make machine learning font design more practical.

3. Intelligent Generation of Font Design in Print Advertisements

3.1 Principles of Font Design in Print Advertising

Accurately conveying information and increasing visual aesthetic effect are the two most important functions of font design in print advertising. First of all, the font design in print advertising is for information dissemination services, which needs to be quite practical, be able to quickly convey information, and finally achieve the best visual effect. In the process of design, it must be considered that the text should meet the appeal effect of advertising as a whole, be clearly recognized in the first visual impression, and accurately express the information content. Secondly, the font design in print advertising can increase the visual aesthetic effect, attract and infect the audience with its beauty, and make the advertising effect more profound. Font design can bring aesthetic feeling to the audience, which requires font design to pursue aesthetic effect in form and bring visual pleasure; In terms of content, we should also reflect the beauty of the advertising theme. The font temperament is harmonious and unified with the advertising theme, the audience and the brand image. We should pay attention to the identity characteristics of the font and the artistic expression of the font itself, so as to realize the overall aesthetic coordination. Therefore, the font design in print advertising needs to realize the communication and aesthetic function from three aspects: morphological characteristics, recognition characteristics and cognitive characteristics.

3.2 There are Problems with This Font Design

At this stage, although the intelligent design of print advertising has strong design ability in layout and color, it can well create picture space and convey visual information and aesthetic feeling. However, there are still considerable deficiencies in the font, and the principle of font design has not been well achieved. For example, some posters are hard to generate. On the one hand, this situation is due to the insufficient font resource library of the intelligent system, which is unable to select a more consistent font; on the other hand, only the standard font of the font library is used, which lacks creativity, style and interest in the title font. The text of print advertising intelligent design can also be solved by purchasing font copyright and expanding font library. However, the main visual element of title font puts forward higher requirements for intelligent design, and the font design of machine learning can make up for this deficiency.

4. Test Results and Discussions

4.1 Experimental Procedure

The experiment adopts the combination of subjective questionnaire and objective eye movement

tracking, and carries out Carlo analysis on the obtained data. First, ask the subjects to fill in the questionnaire, complete questionnaire I, and then start the eye movement test. After completing the eye movement test, send Questionnaire II to fill in. The whole process ensures that the subjects have no understanding of the purpose of the experiment. This eye movement experiment adopts eye tracking technology, which is suitable for the test scene directly watched by the eyes and the real world, and can provide high-precision data for the subjects' eye movement in the natural state. The questionnaire was distributed twice before and after the eye movement experiment. The questionnaire questions were set according to the requirements of Carlo analysis and asked questions around the test samples.

The subjects were 20 college students, including 10 males (50%) and 10 females (50%). The subjects were aged between 20-24 years old and had a bachelor's degree or above. The subjects' visual acuity or corrected visual acuity were above 1.0, colorless blindness, weak color and other eye diseases, and they had no understanding of the purpose of the experiment in advance.

4.2 Experimental Materials

The eye movement experiment set up the control group, and sample a was the intelligent generated poster under certain needs; Sample B is the same poster, but the font part is replaced by the font design of machine learning under the same demand. The control group was divided into three groups, and each group made sample a and sample B in the above way. As the experimental subjects are college students, the control group selects and makes samples according to the campus positioning.

4.3 Experimental Measurement Index

Cognitive psychology believes that there are three basic ways of eye movement, namely fixation, saccade and pursuit movement. When the eye stays on an object for more than 100ms, it is fixation, and the fixation process is often accompanied by the brain information processing process; Moving from one fixation point to another is saccade. In saccade, because the viewpoint quickly skips the picture space, it is unable to capture accurate information, so there is no processing process. Following movement is the process of eye movement when subjects look at things, which is often accompanied by a large range of saccade movement and processing. Based on the above three basic eye movements, the corresponding eye movement indexes, fixation time, fixation count and fixation track, have been evolved. Heat map and trajectory map were made by eye movement index to investigate the different aspects of visual attention in the process of viewing.

The questionnaire is divided into two parts, which are set before and after the eye movement experiment, in order to obtain the subject's subjective satisfaction more accurately. The first questionnaire was distributed and filled out before the eye movement experiment. The questions focused on the subjects' preferences for print advertising, guiding the subjects to pay attention to the visual experience and information reception when watching posters, so as to make the data of the eye movement experiment control group more clear. Questionnaire 2 was distributed and filled out

after the eye movement experiment. It mainly asked questions about the posters of the eye movement experiment control group, obtained the subjects' subjective evaluation of the visual effect difference between sample a and sample B, and interpreted the five satisfaction levels of sample B in the control group: necessity, expectation, surprise, neutral and negative.

4.4 Experimental Process

First, explain the test precautions to the subjects and fill in the questionnaire. Then start the eye movement experiment to confirm that the subject's eyes are not blocked, the line of sight is flush with the center of the screen, and the distance between the head and the screen is 60cm. After passing the debugging, start the test. The posters of the same group of test samples appear on both sides of the screen at the same time. The display time is 6 seconds, with an interval of 3 seconds, and the total time is 24 seconds. Finally, the subjects were asked to fill in questionnaire 2 and complete all the tests.

4.5 Experimental Result

In the eye movement experiment, the control experiment successfully generated the hot spot map of sample a and sample B. There was a great difference in fixation time, fixation count and fixation track between sample a and sample B. In the control group 2, the fixation points of sample a were more scattered, and the fixation time and times of the font body were less. The fixation points of sample B were more concentrated in the font body, and the fixation time and times were much greater than that of sample a. It can be proved that the font design of machine learning can well enhance the visual feeling of intelligent "one click generation" print advertising, enhance the attraction of advertising and obtain the attention of consumers. In addition, in the same control group, the subjects' fixation on sample a is scattered and lack of visual center of gravity; Paying more attention to sample B can prove that the font design of machine learning can also strengthen the information transmission effect of intelligent "one click generation" print advertising, enhance the recognition of print advertising, and output brand image or advertising concept.

Through the questionnaire survey of the subjects, it is found that the subjects have higher subjective satisfaction with sample B. sample B can make it easier for the subjects to understand the advertising theme, have higher attraction, and obtain information efficiently. The subjects are also willing to share the advertising and spread it again; At the same time, sample B can arouse the interest of subjects to a higher extent and arouse the desire to participate; Because the visual experience is better and the visual memory of sample B is more lasting, the subjects can recall sample B when talking about the advertising theme. The subjective evaluation of the subjects obtained from the questionnaire is that the visual experience, information reception and cognitive recognition of sample B are higher than that of sample a, and the subjects are more satisfied with sample B.

4.6 Experimental Summary

Through the application effect test experiment, using the combination of subjective questionnaire

and objective eye movement tracking, this paper verifies the effectiveness of introducing machine learning font design into print advertising intelligent generation, and proves its application value. Through the questionnaire survey, we can intuitively understand the subjective feelings of the subjects, and verify that the print advertisement with machine learning font design can effectively improve user satisfaction, and has better morphological features, recognition features and cognitive features. Through the eye tracking experiment, the subjects' gaze time, gaze times and gaze trajectory are objectively recorded. It is verified that the print advertisement with machine learning font design can obtain better visual attention and information communication, better achieve the AIDA principle of advertising design, seize attention, arouse interest, generate desire and promote action.

4.7 Research Limitations

In this paper, it has been pointed out that machine learning font design has been basically mature in the computer field, and has also been applied to font design, artistic word creation and so on. In the field of print advertising, artificial intelligence advertising design and the generation of artificial intelligence posters are also very mature. They are widely used in HR recruitment posters of Internet companies, new media operations and popular personal business cards. The combination of the two is an important direction of intelligent design of print advertising, which further promotes the deep combination of print advertising and artificial intelligence. However, how to incorporate the machine learning training model into the whole print advertising intelligent generation system, and how to further compress the generation time of this system and maintain efficient output need further technical research.

Figure 6 Eye movement experiment control group poster

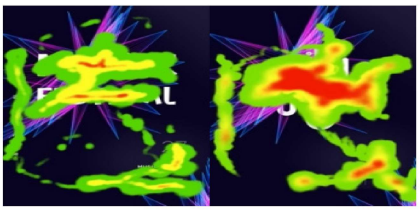

Figure 7 Control group hot spot map

5. Conclusion

The combination of machine learning font design and print advertising is the necessity driven by the demand for advertising efficiency and advertising effect, the emotion driven by consumers' visual experience and advertising satisfaction, and the technology driven by the in-depth development of artificial intelligence and machine learning. The introduction of machine learning font design into intelligently generated print advertising changes the original single way of plane combination relying on copyright font library. It can create a new font style through graphic style migration, handwriting style migration and multiple font style collection. Efficient and diversified generation weakens the third party as a design infinitely, Advertisers enjoy more direct expression of self aura. At the same

time, machine learning font design can follow the font design principles of print advertising, with good morphological features, recognition features and cognitive features, effectively improve user satisfaction, better achieve the AIDA principles of advertising design, seize attention, arouse interest, generate desire and promote action. With the continuous development of technology, the continuous improvement of consumers' demands and the requirements of high efficiency in the advertising industry, the introduction of machine learning font design into the field of print advertising has considerable application value, and the field of machine learning and print advertising will also usher in a more extensive and in-depth combination.

References

[1] Abbasi Maryam,Santos Beatriz P.,Pereira Tiago C.,Sofia Raul,Monteiro Nelson R. C.,Simões Carlos J. V., & Arrais Joel P. (2022). Designing optimized drug candidates with Generative Adversarial Network. Journal of Cheminformatics, (1). doi:10.1186/S13321-022-00623-6.

[2] Lu, L., & Guan X. (2021). Research on the design method of Braille Chinese character library generated by artificial intelligence. Design Art Research , (06), 49-52.

[3] Wang, D. M. (2021). Based on the art and design research in the era of artificial intelligence. Art Research, (04), 77-79. doi:10.13944/j.cnki.ysyj.2021.0228.

[4] Lin, W. q. (2021). Application and exploration of artificial intelligence technology in art design. Grand View, (08), 88-91.

[5] Wang, L. (2021). Research on heterogeneous image migration and enhancement based on generative countermeasure network [Master's thesis, University of Electronic Science and Technology]. https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202201&filename=1021746896.nh

[6] Chen, Q. (2021). Research on automatic generation method of Chinese characters based on generative confrontation network [Master's thesis, Jiangxi Normal University]. https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202201&filename=1021650439.nh

[7] Xie, Z. P., Xiao, T. T., & Qin, H.Y. (2021). The "stealing skill" of words: the font effect in marketing. Advances in Psychological Science , (02), 365-380.

[8] Zhao, Z. M., & Yan, W. Q. (2022). Research on the design strategy of "Chinese dream" print advertisement based on comprehensive communication mode. Packaging Engineering (02), 387-392. doi:10.19554/j.cnki.1001-3563.2022.02.052.

[9] Zeng, Z., Liao, X., & Lu, X. (2020). Exploration of Chinese character font design based on machine learning. Packaging Engineering, (18), 48-52. doi:10.19554/j.cnki.1001-3563.2020.18.006.

[10] Yin, Y. K., Chen, H., & Zhao, H.Y. (2020). The application of artificial intelligence in art design. Packaging Engineering, (06), 252-26.1. doi:10.19554/j.cnki.1001-3563.2020.06.039.

[11] Li, Z. Y. (2019). A comparative study on visual information and form layout design of Chinese and English characters. Packaging Engineering, (14), 58-62. doi:10.19554/j.cnki.1001-3563.2019.14.010.

[12] Yang, H., & Duan, K. (2019). Chinese font design in AI era. Design, (14), 134-136.

[13] Zhang, G. Z. (2019). Cyclogan based font style transfer algorithm and its application [Master's thesis, Xihua University]. https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD202001&filename=1019266871.nh

[14] He, J. (2019). Research on Chinese character font design based on machine learning. Fortune today, (02), 41.

[15] Zhou, H. W. (2019). Research on the relationship between art design and artificial intelligence. Art and design (Theory), (z1), 26-27. doi:10.16824/j.cnki.issn10082832.2019.z1.002.

[16] Zhao, Y. P. (2016). Inheritance and Innovation -- new exploration of Hanyi font in the era of mobile Internet. Decoration, (07), 67-71. doi:10.16272/j.cnki.cn11-1392/j.2016.07.029.

[17] Jiang, C. L. (2014). Research on font design in print advertising [Master's thesis, Jiangsu Normal University]. https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201601&filename=1015967924.nh